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Observed and Simulated Trends in Heavy Lake Effect Snow Events Across the Great Lakes Basin

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Abstract: We propose a combined observational and modeling analysis, focusing on the detection and attribution of trends in heavy lake effect snowstorms across the Great Lakes Basin. These extreme events impose a substantial economic and social toll, including fatalities and injuries, loss of power, transportation immobilization, vegetation die-off, and structural collapses. While an increasing focus has been given to extreme events in recent years, extreme lake effect snowfall remains largely unexplored, both in observations and model prediction studies. Observational data suggests that lake effect regions experienced an increase in total snowfall during the 20th century, but it is unclear if heavy lake effect snowstorms have become more abundant. We will develop a climatology of observed extreme lake effect snowstorms in the Great Lakes Basin and assess observed trends in their occurrence.
It is likely that future climate change, related to rising concentrations of greenhouse gases, will result in changes in the frequency and intensity of heavy lake effect snowstorms. The latest IPCC Assessment Report includes an array of state-of-the-art global climate model predictions, yet these models either fail to represent the Great Lakes or significantly underrepresent them. We propose to use two regional climate models (differing only in cumulus parameterization) with 20-km horizontal grid spacing, driven by the large-scale fields of several IPCC AR4 global models, to predict future trends in heavy Great Lake effect snowstorms in a probabilistic trend analysis. The regional model will be interactively coupled to a one dimensional thermal eddy diffusion lake model, allowing for the simulation of lake ice. We will relate trends in heavy lake effect snowstorms to changes in ice cover, cold air masses, air-lake temperature contrast, storm tracks, atmospheric moisture, wind flow, and teleconnection patterns.